

**Research Note :****HIGH DENSITY PLANTING SYSTEM IN TROPICAL FRUITS****A. K. Goswami*, Jai Prakash and A. K. Singh***Division of Fruits and Horticultural Technology, IARI, New Delhi-110012***E-mail: amit.tkg@gmail.com*

ABSTRACT : HDP is one of the novel methods to achieve high productivity per unit area both in short duration and perennial horticultural crops. High yield and high fruit quality can be achieved with a high-density orchard when the orchard has good light distribution throughout the tree canopy and there is a balance between vegetative growth and cropping. Planting density is one of the most important factors which determine the yield of an orchard. After the first few years, fertilization regime should be maintained with a balance between fruiting and cropping. Excess fertility often results in excessive vegetative growth, delayed cropping and soft and poorly coloured unmarketable fruit. The goal of HDP is to get the trees into cropping as soon as possible from a limited space. This is best accomplished by following proper pruning and training regime combined with a precocious rootstock to obtained significant production.

Keywords: *Meadow orcharding, pruning, dwarfism, PGR.*

The continuing decline in the availability of cultivable land, rising energy and land costs together with the mounting demand of horticultural produce, have given thrust to the concept of high density planting (HDP) of horticultural crops. HDP is one of the important methods to achieve high productivity per unit area both in short duration and perennial horticultural crops. Being an intensive system, it requires more capital to establish and is more productive and profitable, if followed scientifically. High Density Planting (HDP) is a very intensive form of fruit production which has high relevance to the food and nutritional security of our ever increasing population (Anon., 1).

HDP system is normally understood as a system in which a higher number of plants are accommodated within a unit area in comparison to the conventional planting density. The HDP enable to raise the productivity from the land considerably. The increase in productivity is often more the proportional to the expenses and consequently the net return per unit amount of investment is considerably enhanced. Many fruit trees are now grafted on to size controlling clonal rootstock and planted at much higher densities. The main aim of HDP is to achieve the twin requisites of productivity by maintaining a balance between vegetative and reproductive load without impairing the plant health. The underlying principle of HDP is to make the best use of vertical and horizontal space per unit time and to harness maximum possible return per unit of inputs and national resources.

Key aspects of HDP in fruits :

The HDP can be with one species (mono-species) or with different species (multi-species, multi-storeyed) of crops. The mono-species HDP basically comprise the planting of small tree densely, restricting their vegetative growth by using dwarfing rootstocks, bio regulators or other horticultural technique such as pruning thereby, diverting much of the plant energy to the economical parts. In the multi-species HDP, the interception of incident solar radiation at different tiers by canopies of various species based on their light transmission characteristics and shade tolerance are exploited.

Five important components of HDP are (i) Dwarf scion varieties, (ii) Dwarfing rootstocks and inter-stocks, (iii) Training and pruning, (iv) Use of chemicals/PGR, and (v) Suitable crop management practices. These components are harnessed in HDP which helps in attaining the goals.

At present majority of temperate fruit orchards in Europe, America, Australia, New Zealand, Israel and Japan are under intensive systems of fruit production. There are several fruit crops where success on their HDP has been achieved, e.g. apple, peach, plum, sweet cherry, pear among temperate fruits and banana, pineapple, papaya among tropical fruits. In India, HDP technology has been successfully tried in banana, pineapple, papaya and recently in mango, guava and citrus especially Kinnow.

Present Status of HDP in Some Tropical Fruit Crops :

Mango yields worldwide are generally poor, ranging from 4 to 9 t/ha. This is partly attributable to wide tree spacing, which are traditionally based on expected eventual tree size. Canopies of these mango trees often take more than 10 years to fill the allocated space in the orchard row. Little consideration is generally given to canopy size maintenance once the overcrowding eventually occurs. High density concept of orcharding in mango took practical shape after the release of Amrapali. Most of the commercial varieties of the mango are irregular bearer and generally planted at a distance of 10 to 12 m, accommodating about 70 to 100 plants/ha, while Amrapali variety, being distinctly dwarf, has been recommended by IARI to be grown at 2.5 x 2.5 m (triangular method) and accommodating 1,600 plants/ha yielded up to 22 t/ha. The high-density orchard provides several times (8-9) higher yields than the traditional densities (Gunjate *et al.*, 6). Dushehari mango at 2.5m x 3m (1,333 plants/ha) can also be raised under HDP with pruning and dehorning after the harvesting. HDP has also been achieved with the application of paclobutrazol. Successful HDP (666 plants/ha) plantations of different commercial varieties namely Kesar, Alphonso, Tommy Atkins, etc. has been demonstrated by the Reliance Agro Ltd. at Jamnagar (Gujarat) under arid agro-climate (Biswas and Kumar, 4; and Bhosale, 3). **Guava** is an important fruit crop in tropical and subtropical regions and there is a worldwide trend to plant fruit trees at higher density or meadow orcharding. In guava higher yield and quality production is achieved from densely planted orchards through judicious canopy management and adoption of suitable tree training systems. In an experiment at CISH, Lucknow, meadow orcharding was found suitable for ultra high density system of planting in guava. The meadow orchard system of guava accommodates 5000 plants/ ha, at a spacing of 2.0 x 1.0 m and managed with regular topping and hedging during initial stages which help in controlling tree size and extending fruit availability. In meadow orcharding, a single trunk tree with no interfering branches up to 30 - 40 cm from the ground level is desirable to make dwarf tree architecture (Singh, 7). Pruning is continued so that plants remain dwarf in stature. After a year, pruning operation is done especially in May-June, September-October and January-February. Due to availability of dwarf clones in **Banana**, HDP is gaining

popularity. Dwarf Cavendish and Robusta are fit to be planted under high density planting at a planting distance of 1.2m X 1.2m (6,944 plants/ha) in a rectangular system of the planting under a proper nutrient management practice. Yield realization varies from 86 t/ ha in Basarai at 1.5 x 1.5 m to 174 t/ha in Robusta planted at 1.2 m x 1.2 m spacing (Athani *et al.*, 2; Prabhu, 6). Dwarf varieties of **Papaya** like Pusa Dwarf, PusaNanha and Ranchi make possible to grow papaya under the HDP concept. Normally, papaya varieties are planted at a distance of 2.5 m X 3 m or 2.5m X 2.5 m, which accommodates 1,333 to 1,600 plants/ha, while PusaNanha may be planted at a distance of 1.25 x 1.25m (6,400 plants/ha). Such orchards may give 3 to 4 times higher yields (60 to 65 tonnes/ha) in comparison to the yield of the traditional orchards (15 to 20 t/ha) with the superb combination of drip irrigation with dwarf varieties. Other varieties like CO-1, CO-2, Pusa Dwarf and Honey Dew-1 are also suitable for high density planting. (Bhosale, 3) A novel concept of HDP in **Kinnow** was developed by raising Kinnow mandarin on Troyer Citrange rootstock at a planting distance of 2x2 meter (2500 plants/ha) in square system of planting and allowing multiple shoots to come out above the bud union. Plants raised on this rootstock are precocious and start bearing after 3 years of planting in the field with an average yield of 60 to 80 fruits per plant. Management of such orchards is highly economical due to better conservation of soil moisture, judicious application of nutrients and minimum cost of intercultural operation. Similarly, Cleopatra mandarin rootstock was ideal for Mosambi sweet orange and for Khasi mandarin, a spacing of 5m x 5m (400 plants/ha) was found ideal. **Pineapple** is grown traditionally at low density (15,000 to 20,000 plants/ha) leading to low productivity and an increased production cost. Kew and Queen cultivars are found highly suitable for HDP using double row method of the planting suckers or slips spaced at 25 to 30 cm in the rows at a distance of 45 to 60 cm with a spacing of 90 to 105 cm between the beds (63,000 plants/ha). There is ample scope for expanding area under HDP for the benefit of the fruit growers through higher productivity. The average productivity of pineapple is 15.4 ton/ha but with the adoption of HDP and modification of planting system, higher yield can be obtained. The highest fruit yield (61 ton/ha) in Kew cultivars may achieved with a population of 63700 by following 22.5x60x75cm (Plant x Row x Trench) spacing.

Merit of HDP over Normal Planting:

High density orcharding appears to be the most appropriate answer and need of the hour to overcome low productivity and long gestation period for early returns and export quality fruits.

- ✓ HDP facilitates better utilization of solar radiation and increase in bearing surface per unit land area.
- ✓ HDP plants are precocious, easily manageable and fetch higher return per unit area.
- ✓ HDO have better amenability to modern, input saving horticultural techniques such as drip irrigation, mechanical harvest etc.
- ✓ The use of dwarf trees and managing excessive vegetative growth gives higher productivity and harvest index as well as early economic returns.
- ✓ This system is more amenable to horticultural operations such as pruning, plant protection measures and harvesting which reduces the labour cost involved.

Constraints in Adopting High Density Planting Systems

- ✓ Poor availability of planting material in dwarf varieties as well as vegetatively propagated rootstocks in different horticultural crops.
- ✓ Lack of standardization of production technology in HDP of various fruit crops.
- ✓ High density planting needs higher initial establishment cost as compare to traditional system of planting.
- ✓ Avoidance in use of inter and mixed cropping system.

- ✓ Need for a more professional and scientific approach for management compared to the conventional planting at wider spacing.
- ✓ Crowding and intermingling of branches may occur in coming years which can result in poor performance of trees.
- ✓ Non availability of complete package for HDP and use of mechanization.

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